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ABSTRACT

To aid the student or researcher in the development of an effective procedural schematic (a graphic description of a research plan showing the steps needed to reach a stated objective), guidelines are presented under three topic headings: Compositional elements, taxonomy of research terms, and examples of procedural schematics. An introduction discusses research as a planned activity and the benefits of procedural schematics. The second section defines and illustrates in graphic form the various elements of a procedural schematic: Activity, arrows, columnar segmentation, connector, constraint, events, format, junction points, loop, sequential events, simultaneous events, and time and phasing. Section three, a taxonomy of research terms used in a schematic, defines the following: Planning the study, tentative problem, feasibility study, statement of problem, background study, research design, pilot study, main study, collect and record data, analyze data, conclusions, validate conclusions, and recommendations for further study. The final section is made up of four examples of procedural schematics for research: One that is developed from material presented in this guide, one illustrating sequential events, one utilizing feedback loops, and one utilizing columnar segmentation and horizontal format. A bibliography is included. (JT)

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GUIDELINES FOR THE DEVELOPMENT OF PROCEDURAL SCHEMATICS FOR RESEARCH

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Also, to Mr. Jon Miasnik for his advise and example of a procedural schematic.

A special acknowledgment is extended to Dr. Donald Maley for providing the opportunity to write this guide.

PREFACE

A desirable element of any research proposal or presentation is the inclusion of a succinctly visual and comprehensive procedural schematic. Often the researcher or student has had little or no experience in the development of effective procedural schematics. It is justified to say that in this instance the individual must seek out information to enhance or build a general knowledge of procedural schematics.

The purpose of this guide is to aid the student or researcher in this endeavor by providing guidelines for the development of procedural schematics for research. Specifically this guide emphasizes:

- Defining the basic compositional elements of a procedural schematic
- Developing a taxonomy of research terms used in a procedural schematic.
- Synthesis of research terms into an effective procedural schematic.

The selection of material to be included in this guide was based upon a desire to assist the individual in the development of procedural schematics for research. Therefore, information should be treated as a guide rather than instructions or inflexible rules.

M. D.
Jan.,1977

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1. INTRODUCTION

1.1 Research is a Planned Activity

Research is not an aimless, undirected activity where the researcher sets forth to haphazardly stumble across the needed discovery or information. Rather than a fortuitous occurrence, research requires a definite plan, direction, and design.

The process of proceding from the initial contact with the problem to the resolution of the problem must be purposeful and productive. Therefore, research is an orderly procedure, planned, and logical in sequence.

1.2 Procedural Schematics

A research procedural schematic is a graphic description of the research plan showing the steps needed to reach a stated objective. The graphic network is comprehensive. It includes significant interdependencies and interactions required to complete the research endeavor. The graphic form consists of rectangles that contain textural information and interconnecting line segments. Each rectangle represents an event. An example shell of a procedural schematic is shown in Figure 1.1.

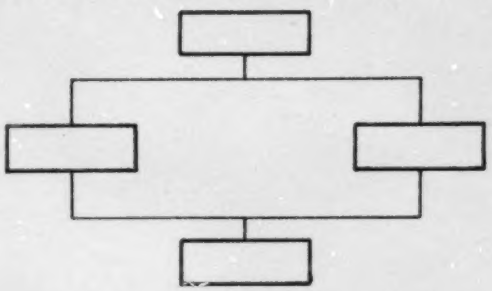


Figure 1.1 An Example Shell of a Procedural Schematic

1.3 Benefits of Procedural Schematics

Procedural Schematics are capable of conveying relevant facts, ideas, and relationships in a comprehensive and understandable form. Material that is presented in a textural form is often too complex to envision the scope of events without thorough inspection. When presented in graphic form events and their

necessary sequences are given clarity and meaning.

Not only will this be an aid to the reader, but also, a medium whereby the writer can clarify, check, and develop ideas or tighten the logic of argument.

2. COMPOSITIONAL ELEMENTS

2.1 Compositional Considerations

When constructing a procedural schematic there are certain compositional considerations one should observe. The following elements are not inclusive, but were selected to provide an overview of contributing elements.

2.2 Activity

An activity is a task that must be completed before moving to the next event. Activities are represented by lines in a procedural schematic. See Figure 2.1.

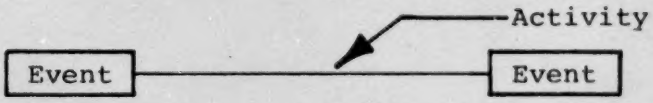


Figure 2.1 Activities are Represented as Lines

2.3 Arrows

Arrows denote the direction in which the activity is moving from one event to another. See figure 2.2.

Activity Moves from Event A to Event B

Figure 2.2 Arrows Denote Direction of Activity

2.4 Columnar Segmentation

Columnar segmentation refers to a method of segmentating procedural flow into major categories of information, method, or operations involved. Major categories should be descriptive and enhance the overall visual impact of the schematic. See Figure 2.3 for an example of columnar segmentation used in procedural schematics.

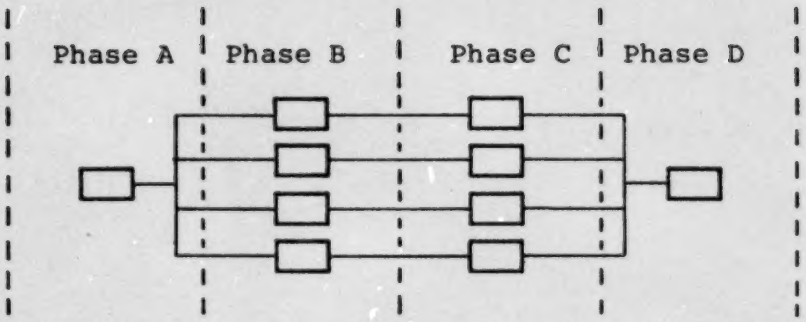


Figure 2.3 Columnar Segmentation used in a Procedural Schematic

2.5 Connector

The connector is used to indicate where activity has been interrupted so that it may be continued on a subsequent page. It is necessary to use a connector when subjected to size limitations or when the complexity of the schematic requires a minimum of two pages. The connector should appear on both pages to indicate where the activity (or activities) have been severed. See Figure 2.4.

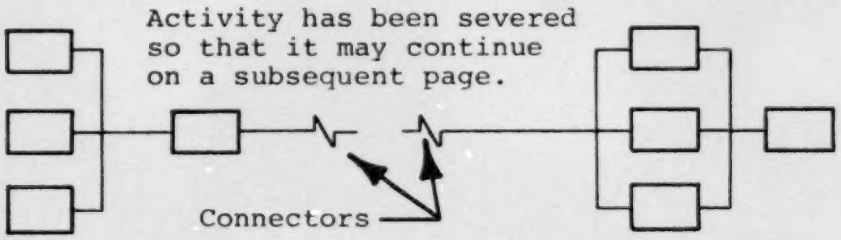
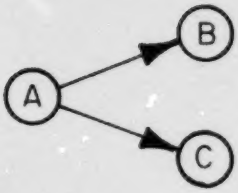


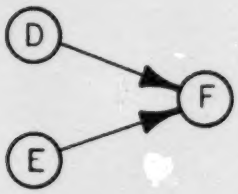
Figure 2.4 Connectors used to continue activity on a Subsequent Page

2.6 Constraint

A constraint is the relationship of an event to the succeeding activity whereby the activity can not proceed until the event has been completed. See Figure 2.5 for the relationship between activities and events that illustrate contraints.



Event A Constrains Activities A-to-B and A-to-C



Events D and E Constrain Activities D-to-F and E-to-F

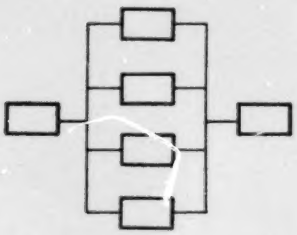
Figure 2.5 Illustration of Constraints Developing from Relationships Between Activities and Events

2.7 Events

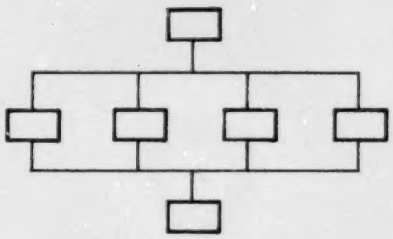
An event is a specific descriptor specifying the initiation or completion of one or more activities. It must identify a significant step of the total accomplishment. Also, care must be exercised so that an event is clearly defined.

2.8 Format

Format is the framework that dictates the physical organization and arrangement of the visual message. One will find procedural schematic format considerations are based upon the selection of either a vertical or horizontal format. See Figure 2.6 for examples of vertical and horizontal formats.



Horizontal Format



Vertical Format

Figure 2.6 Vertical and Horizontal Formats

2.9 Junction Points

Junction points are used to combine several activities into one activity, or to separate a single activity among several alternative activities. Frequently there are situations where two or more activities must converge upon one event. Also, one event may signify the initiation of two or more activities. One will need to employ the use of a junction point to denote a common gathering point in this case. See Figure 2.7 for examples of junction points.

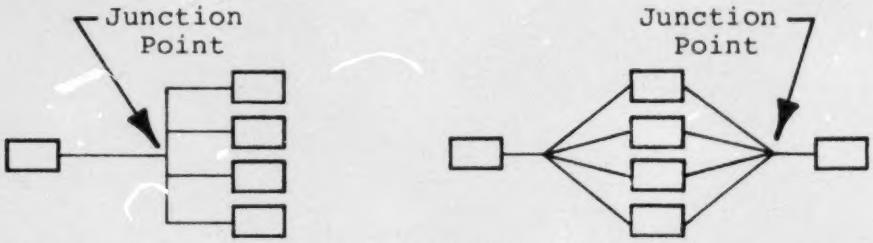


Figure 2.7 Examples of Junction Points

2.10 Loop

A loop is a series of activities which are carried out repeatedly until some terminating condition is satisfied. Loops are particularly useful when encountering a restraint that specifically requires the activities of two or more predeeding events for rectification. Also, loops provide a means for getting feedback information to prior events. See Figure 2.8 for an example of a loop.

Event D. represents a restraint to activity so that if event D cannot be accomplished at any time, activity must be recycled through the proceeding events A, B, and C.

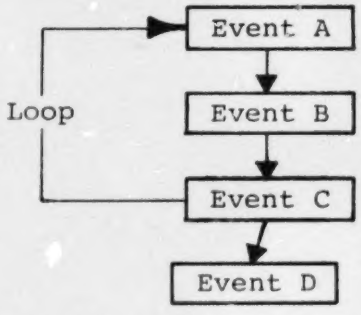


Figure 2.8 The Function of a Loop

2.11 Sequential Events

Sequential events are the relationship between events or activities that occur whenever events or activities must be completed in succession. Sequential events are imposed when events or activities are ordered in a linear manner. Succeeding activities and events are singular, thus there is only one direction for the flow of activity. All activity must take place in a predetermined sequence through one channel as in a chain of events. See Figure 2.9.

Figure 2.9 Relationship of Sequential Events

2.12 Simultaneous Events

Simultaneous events are a division of activity so that more than one event is accomplished in any interval of time. Simultaneous events take place within a network. During the development of a schematic one may find two or more independent events which could take place simultaneously. This situation requires a schematic that makes provisions for the selection of one or more routes to succeeding events. This is done through the use of the network approach. See Figure 2.10 for an illustration of the network approach.

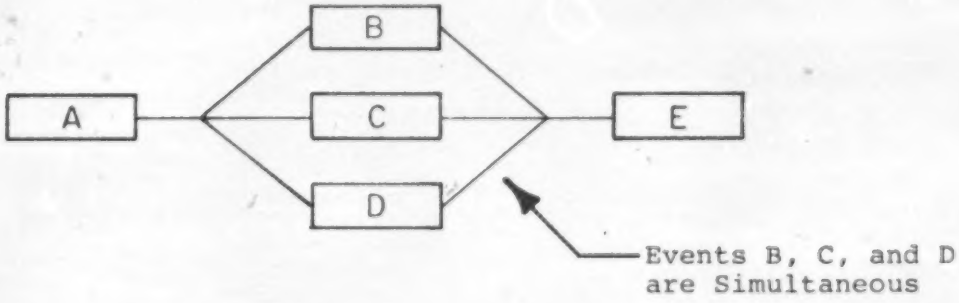


Figure 2.10 Illustration of the Network Approach's Application to Simultaneous Events

2.13 Time and Phasing

Time and phasing is a method of specifying time elements within the framework of the schematic. Often complex research designs require time and completion scheduling considerations. The utilization of time and phasing as the major categories in a columnar segmentated schematic satisfies these desires. Titles for major categories could refer to specific events or general information, such as, Phase I, Phase II, etc. The specified time elements could be either number of days, months, and/or years required or a specific ordering of dates. See Figure 2.11.

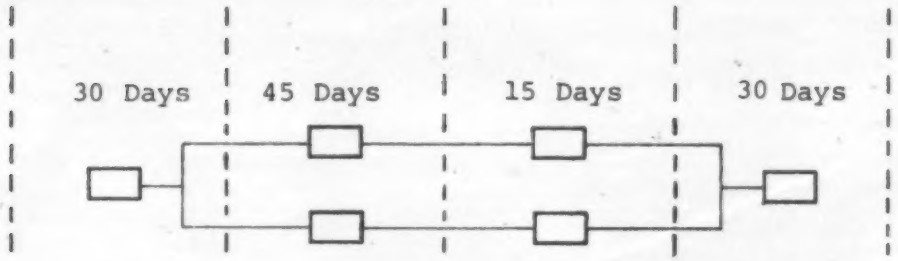


Figure 2.11 The Utilization of Time and Phasing in a Procedural Schematic

3. TAXONOMY OF RESEARCH TERMS

3.1 Planning the Study

Planning is essential to the success of any research endeavor. The researcher needs to develop a systematic approach or methodology to facilitate the study. Also, the plan must be thorough. The following taxonomy is presented to guide the researcher in that task.

3.2 Tentative Problem

The tentative problem is a purposed research problem selected for further consideration and possible acceptance. The primary objective of identifying a tentative problem is to focus the researcher's efforts on a specific subject. One must decide what problem to investigate in starting a research study. The tentative problem provides the initial reference of directing the researcher toward an investigation into the feasibility of the study. The selection of a tentative problem should center around the following guides:

- Area of interest
- Gaps in knowledge
- Inconsistencies in personal studies
- Consultation with experts
- Dissertation abstracts
- Recommendations for further study found in masters theses, doctoral dissertations, and research reports

3.3 Feasibility Study

A feasibility study is a comprehensive investigation of the tentative problem's merit and restrictive factors. The researcher will evaluate his/her ability to successfully complete the research study and provide information that is of value. The objective of the feasibility study is a determination of either accepting the tentative problem or formulating a new tentative problem. The success of a research study depends largely on the care taken with preliminary preparations. Therefore, the researcher must consider pertinent factors before pursuing the tentative problem. The consideration of the following guides will aid the researcher in this endeavor:

- Need for the study
- Availability of relevant information
- Researcher's knowledge in the area of interest
- Facility requirements
- Material requirements
- Time limitations
- Cost or budgetary limitations

Information needed for the feasibility study is obtained through:

- Telephone inquiries
- Review of literature
- Solicitation of information from manufacturers and organizations
- Consultations

3.4 Statement of Problem

The statement of the problem is a written expression that delineates the problem of the study. It should clearly state those elements of the study that are to be managed. The statement of the problem provides an accurate description of the problem. This will benefit the researcher in establishing distinct content for the background study. Also, a descriptive statement of the problem is essential to guiding the researcher toward achieving a meaningful outcome. The effectiveness of subsequent activities in the research study are directly related to the quality of the statement of the problem. One should consider the following elements when writing the statement of the problem:

- Description of the subject or topic
- Conditions of the study
- Objectives of the study
- Variables involved in the study

3.5 Background Study

The background study is an in-depth compilation of information pertaining to the problem of the study. Information gained through the background study is utilized to increase the researcher's expertise on the chosen topic. Also, during the background study the researcher is looking for gaps in present knowledge, differences between reports by various writers, and inconsistencies between observed and stated aspects of the problem. Through the background study one will secure information required to write effective elements of the research design. Specifically the background study should center around the investigation of information gained from:

- Manufacturers
- Organizations
- Literature
- Consultations

3.6 Research Design

The research design is a series of statements that define the conditional elements of the study. A thorough consideration of research design elements will establish intelligible research criterion. The research design involves the following elements:

- Statement of the purpose
- Statement of the need
- Statement of limitations
- Statement of assumptions
- Statement of hypothesis
- Statement of procedure

3.7 Pilot Study

The pilot study is a trial experiment. Its purpose is to check out the procedure of the study. It is seldom desirable to undertake a final research endeavor without conducting a modest preliminary experiment. The small-scale experiment will indicate whether a full-scale experiment is warranted. Also, the pilot study affords an excellent opportunity to

evaluate both the validity and reliability of the study. Inputs to the pilot study would include:

- Test apparatus
- Test samples
- Checks for validity
- Checks for reliability

3.8 Main Study

The main study is a full-scale experiment based upon the procedure verified through the pilot study. It is the researcher's method of procuring reliable and valid data eventually used in the acceptance or rejection of the hypothesis. Inputs to the main study would include:

- Test apparatus
- Test samples
- Checks for validity
- Checks for reliability

3.9 Collect and Record Data

Collect and record data is the point where the researcher organizes data in an orderly and systematic manner for analysis. It is primarily the task of gathering data into a workable form that yields easy access to individual data.

3.10 Analyze Data

Analyze data refers to a transformation of raw data into meaningful data. This facilitates an interpretation of data and provides additional information for determining the results of the study. One would analyze data through the following methods:

- Graphic presentations
- Statistical treatments

3.11 Conclusions

Conclusions are decisions or statements formulated by the researcher that identify the outcome of the study. They are based upon interpretations of data. Utilizing the data derived from the study as evidence, one will either accept or reject the hypothesis. Also, conclusions are relevant to studies that do not incorporate hypothesis. These studies require conclusions based upon the existence or non-existence of substantiating data.

3.12 Validate Conclusions

The validation of conclusions is a procedure whereby the researcher minimizes suspicion that his/her personal bias has affected the formulation of a valid conclusion. Since conclusions are made dependent upon personal interpretations of data, the researcher must subject any conclusions to validation. Also, this will yield conclusions that are acceptable to informed people in the field. Validation is accomplished through the following methods:

- Utilization of a panel of experts
- Reference to prior studies
- Application of standards

3.13 Recommendations for Further Study

Recommendations for further study are statements that specify topics for further study in areas worthy of investigation. The determining factors for selecting specific topics are based upon experiences and information gained through the study. The formulation of recommendations for further study will center around the following considerations:

- Unsettled questions encountered in the course of researching the topic
- Generalization of findings to other related areas
- Unforeseen problems encountered in the course of the study

4. EXAMPLES OF PROCEDURAL SCHEMATICS FOR RESEARCH

The synthesis of compositional elements and research terms into an effective procedural schematic is based upon the specific factors of the study. The eventual design of the procedural schematic will be dependent upon those events and inputs used in any particular research study.

A careful evaluation should be made of the events and inputs included in the schematic. It is important to consider the significance and visual impact upon the reader. Information should be comprehensive, yet avoid the inclusion of non-essential information.

Organization is the key to an effective graphic presentation of a schematic. Graphic considerations should include a systematic alignment of rectangles and lines. Also, textural information should be concise and easy to read. Avoid graphic embellishments and over-emphasized features. The effectiveness of a schematic depends upon the reader's ability to envision a specific sequence of events or procedure.

The following section of this paper consists of several examples of research schematics. These schematics are presented as guides for the preparation of schematics for specific research studies. The development of these schematics was based upon the desire to illustrate several concepts presented in this guide. Specifically they are:

- Figure 4.1 An Illustration of a Procedural Schematic Developed from Material Presented in this Guide
- Figure 4.2 A Procedural Schematic Illustrating Sequential Events
- Figure 4.3 Procedural Schematic Utilizing Feedback Loops
- Figure 4.4 Procedural Schematic Utilizing Columnar Segmentation and Horizontal Format

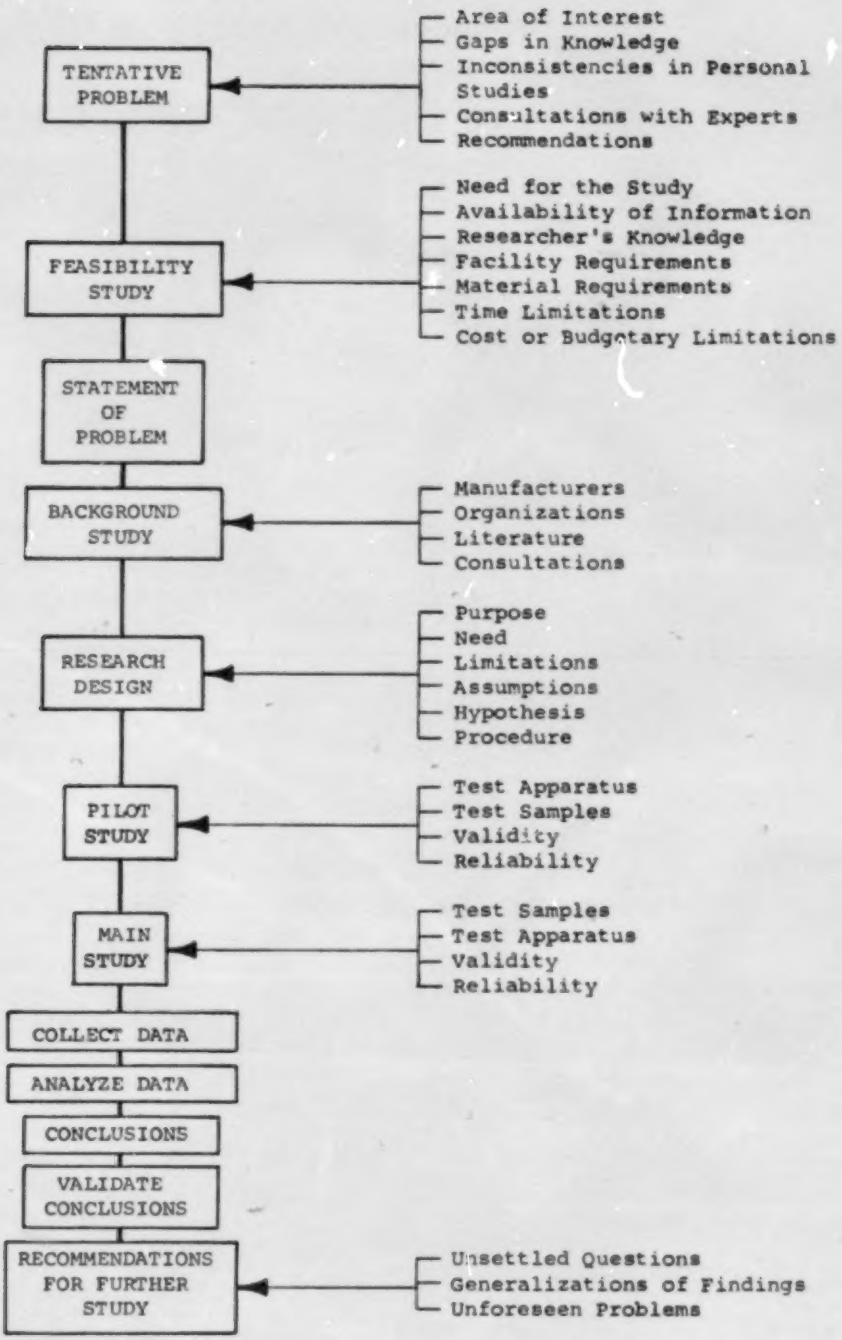


Figure 4.1 An Illustration of a Procedural Schematic Developed from Material Presented in this Guide

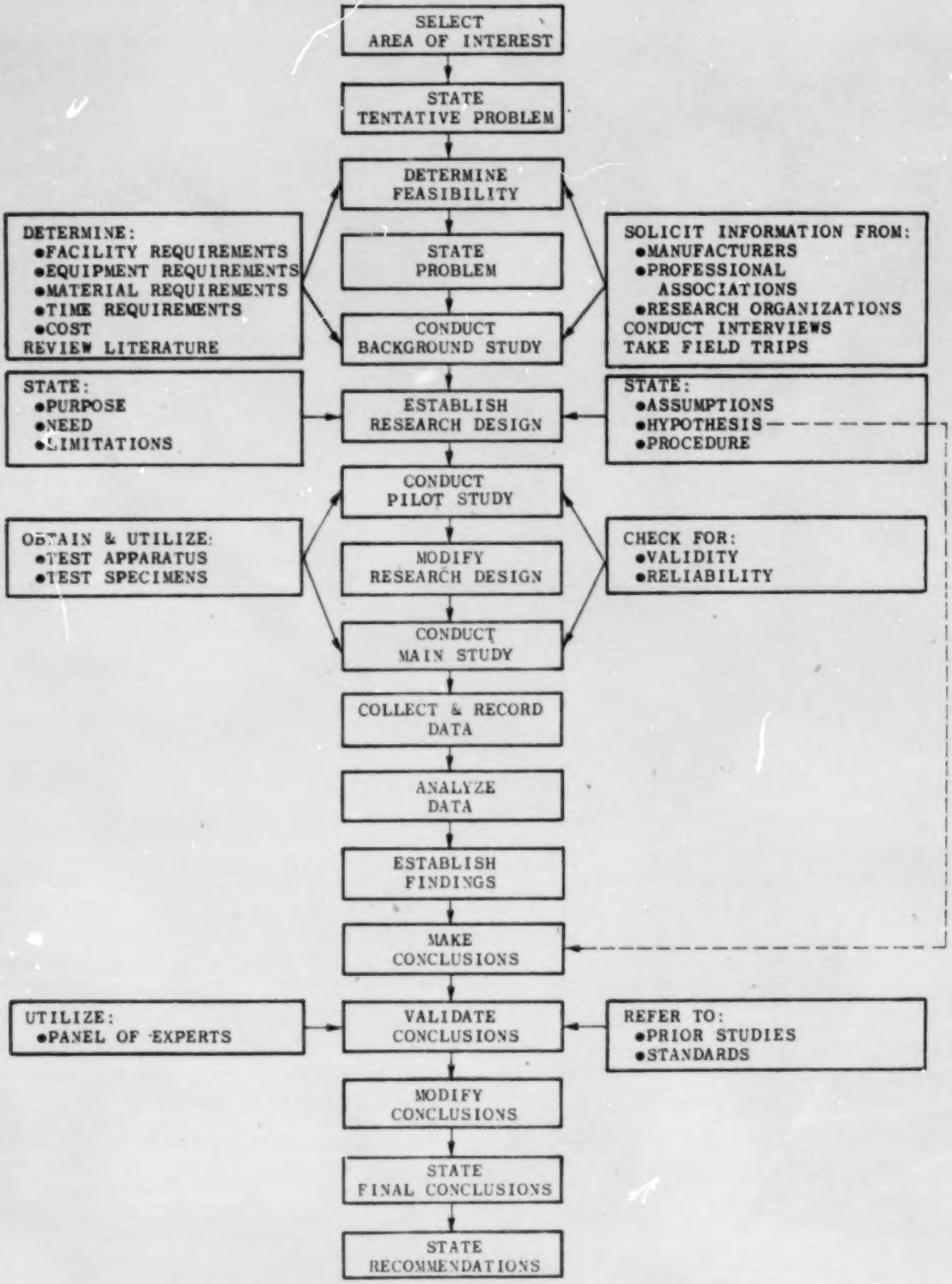


Figure 4.2 A Procedural Schematic Illustrating Sequential Events

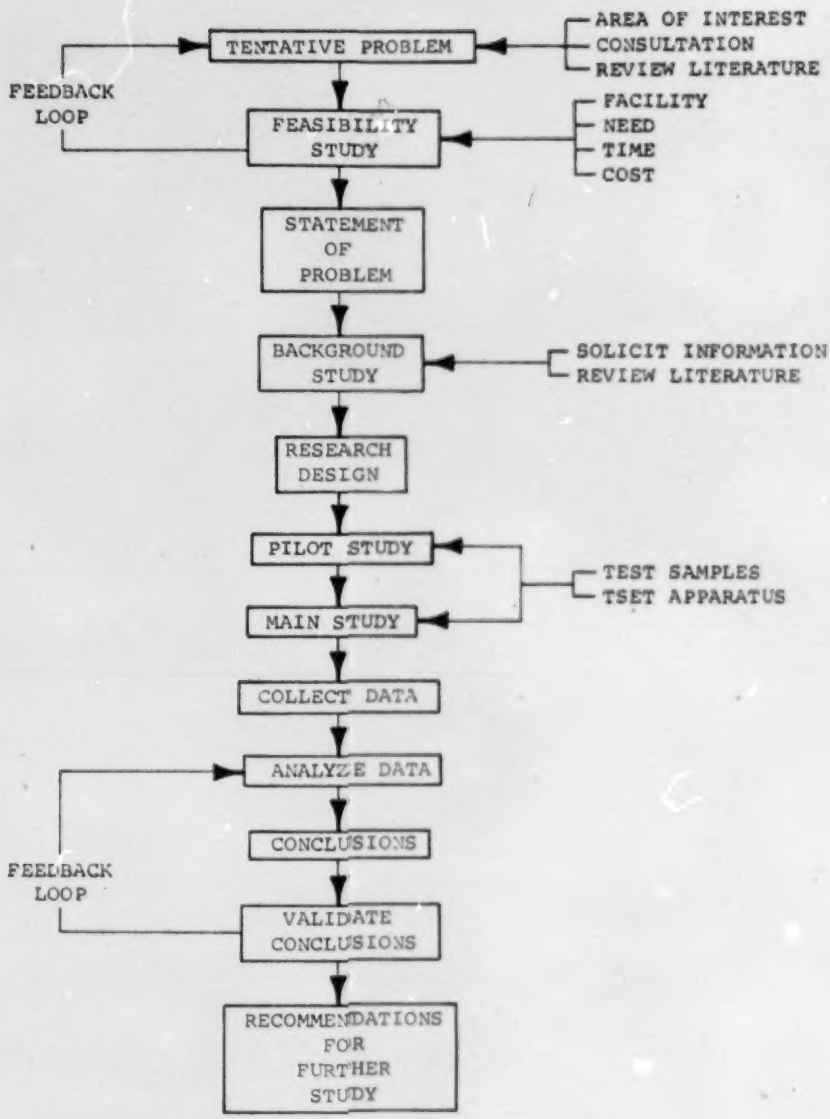


Figure 4.3 Procedural Schematic Utilizing Feedback Loops

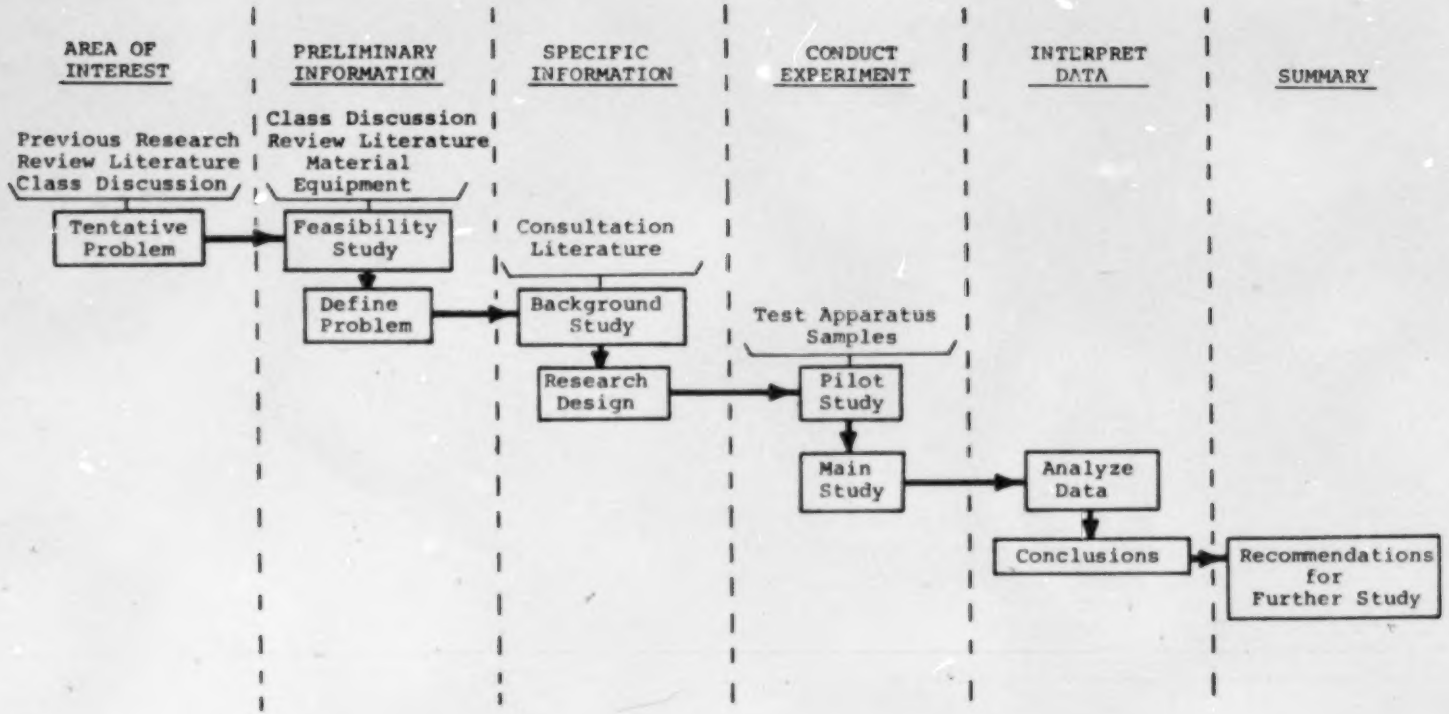


Figure 4.4 Procedural Schematic Utilizing Columnar Segmentation and Horizontal Format

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